

**PERSONAL DIGITAL ASSISTANTS AS A MOBILE INSPECTION SYSTEM  
AT CONSTRUCTION SITE**

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**A project report submitted in partial fulfilment of the  
requirement for the award of the degree of  
Master of Science (Construction Management)**

**Faculty of Civil Engineering  
Universiti Teknologi Malaysia**

**MAY 2006**

*To my beloved Mother and Father.*

*Thank you for your support, guidance and confidence in me.*

## **ACKNOWLEDMENTS**

This project report was completed with the contribution of many people to whom I want to express my sincere gratitude.

First and foremost, I would like to convey my sincere thanks and gratitude to my supervisor, Dr. Arham Abdullah for his patient, time and guidance, throughout the entire research.

Special appreciation also goes to Geobina Solutions and Mr Ewe Hong Cheong from Sunset Villa Sdn. Bhd. and all other individual as well as organizations which participated and contributed towards making this research success.

I am deeply grateful to my family for their unconditional love through the years. Grace Ng Sock Hooi deserves a special mention upon her continual patience, boundless encouragement and support during this study.

Finally yet importantly, I want to extend my grateful appreciation to all the people who have contributed in some way to the completion of this project report.

## **ABSTRACT**

Construction defects are always the key concern of the construction industry. Different constructed facilities generate different types of defects and demanded different levels and types of quality, depending on the functions, system types, and materials used. Nevertheless, construction projects was typically take place in an environment where it is difficult to gain access to conventional computers for use as real-time decision aids as gone through the project quality inspection. The objectives of this study was to identify the inspection process and standard check list used in practice at construction site; to identify the potential and requirement for mobile inspection system at construction site and to develop a prototype of a mobile inspection system for construction site. Data was gathered from the literature study and also through local construction organizations by means of interview questionnaire. A prototype was developed using rapid prototyping method in a final phase. The finding revealed that generally construction industry does not have its standard inspection process and standard check list in practice. Besides this, the study also reveals that there was a potential and requirement for mobile inspection system at construction site. Finally a mobile defect inspection which consists of a sub system checklist and reference system was developed to suit the need of industry. The developed prototype will standardize the way of managing building defects and improve quality, increased productivity of inspectors, accurate photographic records and improved building defect communication.

## ABSTRAK

Kecacatan pembinaan pada amnya merupakan isu yang sering dititikberatkan dalam industri pembinaan. Kemudahan fasiliti pembinaan yang berlainan akan menghasilkan kecacatan dan kualiti pembinaan yang berbeza, dan ini adalah bergantung kepada fungsi dan jenis bahan binaan yang digunakan. Pada amnya, projek pembinaan adalah dijalankan dalam keadaan yang sempit dan menyukarkan seseorang itu bekerja dengan menggunakan komputer biasa di mana ia akan membantu meringankan beban seseorang itu dalam melakukan pemeriksaan kualiti bangunan. Maka objektif kajian adalah untuk menentukan keperluan senarai semakan kualiti yang standard dalam tapak pembinaan; menentukan tahap keperluan terhadap sistem semakan kualiti bangunan mudah alih dalam tapak pembinaan dan membangunkan suatu aplikasi sistem semakan kualiti mudah alih bagi kegunaan dalam tapak pembinaan. Data terhadap keperluan aplikasi sistem semakan kualiti bangunan mudah alih tersebut diperolehi melalui kaedah soal selidik dan juga kajian literatur terhadap industri pembinaan tempatan. Satu model aplikasi telah dibangunkan dengan cara *rapid prototyping* pada fasa akhir kajian ini. Hasil daripada kajian ini menunjukkan bahawa industri pembinaan tempatan pada hari ini masih tidak mempunyai suatu senarai semakan dan proses semakan yang standard. Selain daripada itu, keputusan kajian juga menunjukkan bahawa terdapatnya ruang dan potensi yang besar dalam industri pembinaan tempatan untuk penggunaan semakan kualiti bangunan secara mudah alih. Satu model sistem semakan kecacatan mudah alih yang mengandungi sub-sistem senarai semakan dan rujukan telah dibangunkan bagi memenuhi kehendak industri. Model tersebut dapat mendatangkan pelbagai kebaikan dalam pengurusan kecacatan bangunan, peningkatan kualiti dan produktiviti juru semakan, rekod gambaran yang tepat dan meningkatkan komunikasi kecacatan bangunan.

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## ABBREVIATIONS

ADO	ActiveX Data Object
ADODB	ActiveX Data Object Database
ASP	Active Server Page Language
CDMA	Code-Division Multiple Access
DFD	Data Flow Diagram
EDGE	Enhanced Data Rates For Global Evolution
ER	Entity-Relationship
GPRS	General Packet Radio Services
GSM	Global System For Mobile Communication
GUI	Graphics User Interface
IT	Information Technology
LAN	Local Area Network
LCD	Liquid Crystal Display
MDIS	Mobile Defect Inspection System
MSN	Microsoft Network
OS	Operating System
PDA	Personal Digital Assistant
PPC	Pocket Pc
PWD	Public Work Department
RAM	Random Access Memory
ROM	Read Only Memory
SQL	Structured Query Language
TDMA	Time Division Multiple Access
VB	Visual Basic
WLAN	Wide Local Area Network

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Construction projects typically take place in an environment where it is difficult for site officer and project engineers in the construction site to gain access to conventional computers for use as real-time decision aids as they go through the project valuation, building M & E inspection, or the pre and post concrete quality inspection (Trefor, 2003).

In the messy construction site area, it is often hard and inconvenient for the site officer and project engineers to carry bulky plans and reference papers to climbing up and down on the temporary access to go into the construction site or building area. It would seem that the construction industry would be a wide area for the application of handheld computers due to their special features in the light weight, small in pocket size for easier in traveling and mobilization and had own a processing feature and software as much as the desktop personal computers.



However the all most nature of construction projects and the cost of setting up various decision support systems often act as a barrier to implementing the systems. But, the time had change, handheld computers now days are becoming more powerful and less costly and even some of the handheld computers are now embedded in to the cell phone today to improve in organizing the phone and address book and also the daily schedule and this had make the potential to employ these devices widely in construction are become greater and wider.

The information needs at the construction site are varied. Personnel in the field require information to make decisions about the construction processes being conducted and update it updated periodically. They also collect data concerning project progress, quality, and costs. Handheld computing applications will therefore include textual information and graphical information about construction as well as form-based software to collect data.

Reference information is one of the basic uses for which handheld computers can be employed. The specific information included on the handheld device will vary from project-to-project and organization-to-organization. It would be assumed that contractors would place more of an emphasis on installation procedures, and owner organizations would emphasize documentation for inspection procedures and quality control. Typical documentation that can be accommodated on a handheld computer is such as real time progress monitoring of on-site works, remote expert support, on-site collection of qualitative and quantitative measurements, collaborative review of technical drawings, on-site supplier and subcontractor evaluation, on-site evaluation of equipment usage measurements, keeping track of the physical equipment position anytime and anywhere, answering audit checklists and filing audit reports during site audits (Meissner et al., 2001). Therefore, the application of information technology in this field will give more advantages.

IT can be define as the use of electronic machines and programs for the processing, data storage, transfer and presentation of information (Bjork, 1997).

With emerge of the 3G technology today, it had become the best methods to deliver reference content to the handheld devices. One method will be to download entire documents to the handheld computer by physical connection to a desktop computer. But the emerging 3G method is to wirelessly access Web pages on the Internet and display the information on a handheld computer. The advantage of this Web access is that documents can be updated easily and the new content can be made available to all users immediately.

## **1.2 Background of Study**

Traditionally, the construction industry has employed paper-based data capture and communication methods. These were time-consuming and potentially error-prone, and discouraged project managers from using them on a regular basis. Thus people tend to minimize communication with other project participants. Since the various stages and tasks of construction are highly interdependent this minimal interaction in practice causes severe problems, widely reflecting on other partners and the final construction product (Ladh, 1995). It has been recognized for some time that capturing data through handheld computing devices, enabled with suitable wireless capability, can address these problems, thereby increasing operative efficiency and ensuring better integration with the existing project management systems.

A number of construction projects are based on online project collaboration solutions and a new community of virtual construction team members has emerged. This team has two main categories of people who would benefit from the adoption of mobile computing technologies. The first category comprises of workers such as contractor's team executing the project. Such workers require an interface to back-end system to maintain contact with their office based counterparts. The other

category comprises professionals who spend a significant amount of time in the office but quite often have to travel to the different construction sites. Such professionals will need an interface to the information held in their offices both while in transit and while on the site.

The rapid growth of handheld computing devices in recent years has marked the beginning of a real mobile communication capability. From their roots as standalone devices that were reliant upon a cable connection to a desktop PC or a connected mobile phone, handhelds are now evolving to integrate features that enable wireless connection to mobile phone and corporate networks. However to a large extent, current use of mobile communication devices for the construction industry remains limited to use of standalone hand held device (C.J Anumba, 2003).

### **1.3 Previous Research**

Nevertheless the used of PDA and telecommunications are long exists in Construction industry and there are few research been carries out on concept of using obsolesce technology such as concept of using Psion as mobile web browser to browse through the internet at any ware in the paper of “PDA as mobile WWW browsers” (Stefab Gessler, 1995), and also using handheld computer to browse through an electronic document such as e-book in the construction industry and also using a third party software for data collection in the paper of “Applying Handheld computers in the construction industry” (Trefor P. willians, 2003).

Later, the player in the construction industry had aware of the need of more capable mobile computing system in the construction industry due to the booming of information technology, then they had put their mind into and develop a concept of

interaction between mobile computing system and construction in the paper “Mobile Communication In Construction-Trends And Prospects” (C. J.Anumba, 2003). In the paper of “The application of PDA as mobile computing system on construction management” (Kenji Kimoto, 2005) had draft out a stand along construction management prototype where the information collection from construction site is not transmit instantaneous and only can be retrieve and analysis when the mobile device is send back to office, further more the interface use in this prototype is a set of static programs which more to structure engineering analysis. Therefore it can not perform dynamic interaction to collect data due to the dynamic nature of construction environment.

#### **1.4 Statement of the Problems**

Since the office automation at the late 1980s has improved the productivity of office works rapidly until today. Site officer, project engineers and construction managers in Malaysia today have recently handled various types of digital information such as drawings, specification, checklists and daily reports.

However, they still need to access the real construction site to check and manage the construction project. They usually use sheets of paper and/or field notes. As a result, they still have a lot of typical and routine jobs in construction site, such as the collection of construction data and the inspection. A gap in time and space between the outdoor construction site and the office, which leads to the low efficiency, occurs and cause into several issues and problem that have been discussed by the public and government recently. From the issues of computer labs and 16 “sick” schools and five community colleges with structural defects, to the closing of Sultan Ismail Hospital in Johor Bahru because of a fungal outbreak due to faulty air-

conditioning and the latest issues where the key Middle Ring Road in Kuala Lumpur had to be closed after cracks were found.

### **1.5 Objectives of Study**

1. To review the inspection process and standard check list used in practice at construction site.
2. To identify the potential at and requirement for mobile inspection system at construction site.
3. To develop a prototype at a mobile inspection system for construction site.

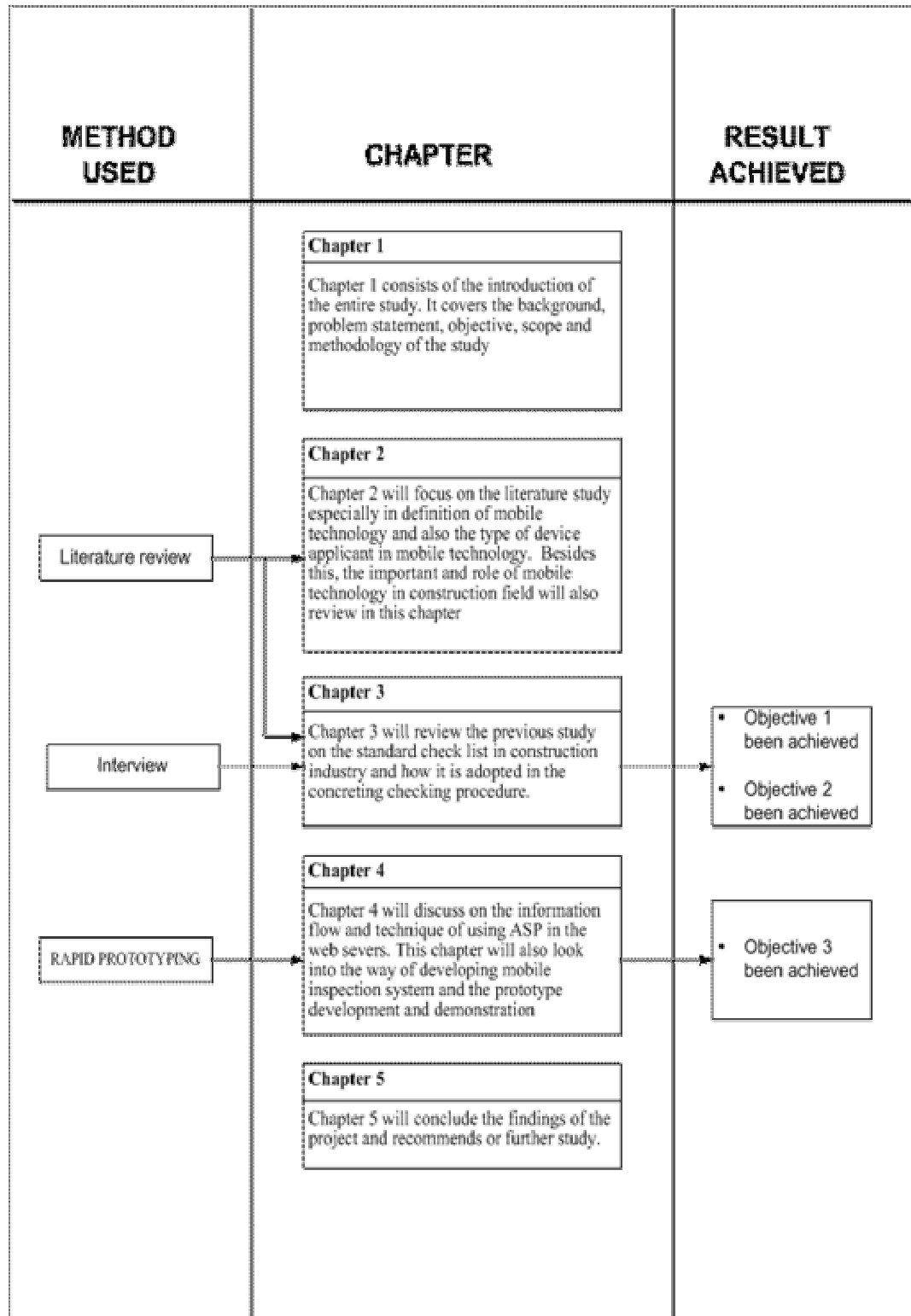
### **1.6 Scope of Study**

The scope of this study will focus on the activity of defect inspection at the final phase construction before handover. Area of this study will only carry out in area of PERAK and JOHOR.

## **1.7 Methodology**

The following methodology has been adopted in achieve the objective list previously: -

1. In order to achieve the first objective which is identify the problems face in construction site and the method of inspection during concreting structure frame, the method for acquisition data will be interviewing construction site personal.
2. However to achieve the second objective which is to identify the potential at and requirement for mobile inspection system at construction site, the method to acquire data is by conducting a literature research on previous thesis which had been carried out before.
3. To achieve final objective which is to develop a prototype at a mobile inspection system for construction site, rapid prototyping method has been chosen to develop the mobile system.



**Figure 1.1:** Study of Methodology Flow Chart

## **1.8 Report Organization**

- a. Chapter 1 consists of the introduction of the entire study. It covers the background, problem statement, objective, scope and methodology of the study.
- b. Chapter 2 will focus on the literature study especially in definition of mobile technology and also the type of device applicant in mobile technology. Besides this, the important and role of mobile technology in construction field will also review in this chapter.
- c. Chapter 3 will review the previous study on the standard check list in construction industry and how it is adopted in the concreting checking procedure.
- d. Chapter 4 will discuss on the information flow and technique of using ASP in the web servers. This chapter will also look into the way of developing mobile inspection system and the prototype development and demonstration.
- e. Chapter 5 will discuss on the evaluation method and also evaluation result analysis of the prototype.
- f. Chapter 6 will conclude the findings of the project and recommends or further study.